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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

FILE COPY

DRAFT

Draft - Injection tests

Reply To
Attn of: OEA-095

MEMORANDUM

SUBJECT: DOCUMENT REVIEW: Injection Test Results - Wells F-3, F-4 and F-4A

FROM: Curt Black
OEA Hydrogeologist

TO: Cathy Massimino
RCRA Project Manager for Occidental Chemical

After our discussion on this mornings conference call with Robert Farrell, I reviewed the above referenced document. As we discussed in the call, the difficulty of placing appropriately located well clusters on the Port of Tacoma property drives us to use indirect methods to assess the effectiveness of the E-line (and to a lesser extent, the F-line) of the Hylebos Waterway hydraulic barrier system.

At your request I have reviewed the F-3 portion of the injection testing report to determine the degree to which it corresponds to the work plan submitted by Occidental Chemical in January 1996.

General Observations:

The work plan is specific in spelling out 4 phases to the testing of each injection well. From Occidental's report, it appears that only step 1 and a modified step 4 are reported. That is, only the slug testing and a variation of the 72 hour test results are provided. The step test (3 constant rate injection tests of one-hour duration each) and the 24 hour variable (optimal) rate injection test appear to have been omitted, or at least, not reported. Finally, the facility failed to operate the 72 hour test as a constant rate test, and instead varied the injection rate haphazardly and without any discernable pattern.

Specific Comments:

These comments are presented in the order of the 4 phases of injection well testing that were described in the work plan submitted by Occidental in January of 1996.

SLUG TESTING

Phase 1 of the injection well testing was to have included, "slug tests at each injection well to provide information. . .". The use of the plural, "tests" leads me to expect multiple tests at each location. Since these tests are so prone to error, so variable in each instance and as interpreted and are so easy to do inexpensively, I would have expected 3 or 4 tests to have been done at each test location. Only one slug test result is presented for each well included in this report.

STEP TESTING

Phase 2 of the individual injection tests was described as, "three constant-rate injection tests at each injection well location, with one hour duration for each constant rate test...to estimate the optimal long-term test injection rates. . .". It seems unlikely that the following steps would have been done without this test or some substitute for it, but the results are not included in the report and should be. Additionally, it would not have been necessary and was not desirable to vary the pumping rate during the 72 hour test as discussed below.

24 HOUR VARIABLE RATE TEST

This Phase 3 test element was not discussed in the report. It seems likely that it was not done. What seems logically to follow the 1 hour duration step test would be a 24 hour CONSTANT RATE test at the optimum rate determined in the step test. This would yield the result discussed in the work plan to, "evaluate the well's performance under fluctuating tide elevations..." This section goes on to discuss determining the minimum injection rate necessary to maintain the overlap of the hydraulic barrier. However, the evaluation of a maximum rate necessary to develop an unambiguous hydraulic barrier was not met due to the elimination of this test element. I would suggest a redesigned test with multiple observation wells to unambiguously demonstrate the geometry and extent of the impressed ground-water mound at each injection site. The test would need to be done for at least 24 hours. A better plan would be to allow 24 hours for the mound to develop, and then collect 24 hours of data to determine the

magnitude and extent of the mound. The extent in 3 dimensions is of concern to the Agency. It will do little good to develop a mound at the 25-foot horizon, only to have increased flux to the waterway at the 50-foot level. Finally, the work plan limitation to 3 tests seems unnecessarily limiting. The facility should embark on a program to determine the rate necessary to clearly establish the hydraulic barrier required here. The facility should test these wells until an optimal rate for injection is identified.

THREE DAY CONSTANT RATE TEST

The pumping rate of this constant rate test varied by 69% of the lowest rate measured, from 1.22gpm to 2.07gpm. The variability reported in Attachment A is too extreme to consider a constant. There are many complicating factors operating on this site and varying the pumping rate prior to interpreting the data seems to add an unnecessarily challenge to the data interpretation. Additionally, a baseline data series of 12 to 24 hours prior to the initiation of injection and following it's end would allow removal of trends in water-level elevation or tidal average, better isolating the point of the analysis, the geometry in 3 dimensions of the hydraulic barrier.

Analysis:

I suggest, in consideration of the above, that these tests be re-done following the work plan. Additionally, I suggest the following changes to result in test results which will better serve the needs of Occidental:

1. Conduct multiple slug tests in each injection well and report the individual values as well as their harmonic mean. Potentially, plot the mean values for each horizon and determine if any meaningful pattern emerges from the observed contoured data.

2. Conduct the step tests and report the data to demonstrate that an optimal rate for injection has been found which does not exceed the rate the well can receive in one hour, but which is expected to be sufficient to yield clearly observable influence at the nearest 2 observation wells in each direction (4 wells minimum, except for the wells at the ends of each line).

3. Conduct the 24 hour OPTIMAL RATE test to demonstrate that the well can take the flow determined in the Step Test throughout an entire tidal cycle. It will ultimately be injection rate, not water level which will determine the adequacy of the hydraulic

barrier to the Agency. We need to determine the geometry of the impressed barrier. For that we need to measure the water levels in wells during the injection tests. But over time, the focus will turn to the injection rate necessary to establish a particular barrier - not the level of the barrier itself. The Agency expects that as the barrier functions over time, water levels in the interior of the plant will rise due to the existence of the barrier and the distance to the recovery wells. Additionally, the seasonal variation in rainfall and the amplitude of the tidal cycle will also diminish the utility of water-level data in assessing barrier effectiveness.

4. Conduct the 72 hour test with a nearly constant injection rate. Collect pre-test baseline data for 24 hours, 72 hours of actual testing and post-test baseline data for 24 hours (possibly longer if the mound doesn't appear to have dissipated in that time period). Utilize the two nearest wells or well clusters in each direction for clear delineation of the three dimensional head distribution developed during the test. In areas (such as near well F-2) where additional well coverage is available, use as many wells as is practicable to develop the pattern of impressed head values. This is particularly important due to the lack of well coverage in other areas of the facility, especially the Port of Tacoma property.

I would be happy to discuss the concerns identified above with either you or the facility. If I may provide any additional information about these comments or this project in general, please contact me at (206) 553-1262.

Thank you for the opportunity to review this report.

Curt Black, Hydrogeologist
Office of Environmental Assessment
US EPA Region X

DRAFT

8/20/96

TO: Cathy Massimino

FROM: Robert Farrell

SUBJECT: OCC- X-SECTIONS

The attached x-sections are the types of products that should be present in OCC reports to demonstrate that the CAP is accomplishing the objectives of creating a mound that overlaps adjoining injection wells or capture zones that overlap adjoining extraction wells.

Bob